1. Find the limit of the following questions: (20%)

(1) $\lim\limits_{x \to \infty} \dfrac{|x|}{|x|+1}$

(2) $\lim\limits_{x \to 0} \dfrac{\sin 5x}{\sin 4x}$

(3) $\lim\limits_{x \to 0^+} \dfrac{\ln(e^x - 1)}{\ln x}$

(4) $\lim\limits_{x \to 0^+} (1 + \dfrac{1}{x})^x$

2. Find the derivative, $dy/dx$, of the following questions: (20%)

(1) $y = \dfrac{x^2 - 1}{x^2 + x - 2}$

(2) $y = 4x\sqrt{x + \sqrt{x}}$

(3) $y = \sin^{-1}\sqrt{1 - x^2}$, $0 < x < 1$

(4) $y = (\sin x)^x$

3. Evaluate the integrals of the following questions: (30%)

(1) $\displaystyle\int_0^{\pi/2} \dfrac{3\sin x \cos x}{\sqrt{1 + 3\sin^2 x}} dx$

(2) $\displaystyle\int \dfrac{4x^3 - x^2 + 16x}{x^2 + 4} dx$

(3) $\displaystyle\int e^{2x} \cos 3x\, dx$

(4) $\displaystyle\int_0^{1/\sqrt{2}} 2x \sin^{-1}(x^2)\, dx$

(5) $\displaystyle\int \dfrac{x^3 dx}{\sqrt{x^2 + 4}}$

(6) $\displaystyle\int_{-\infty}^{1} \dfrac{8x^3 dx}{(x^4 + 1)^2}$

4. If $y' = 6x(x + 1)(x - 2)$, at what points, if any, does the graph of $f$ have a local maximum, local minimum, or inflection point? On what intervals is $f$ increasing, decreasing, concave up, or concave down? (10%)

5. The region in the first quadrant enclosed by the parabola $y = x^2$, the $y$-axis and the line $y = 1$ is revolved about the line $x = 3/2$ to generate a solid. Find the volume of the solid. (10%)

6. Find any local maximum, local minimum and saddle point of the function $f(x, y) = 4xy - x^4 - y^4$. (10%)